



Anatomage Table: Are All Organ Systems Created Equal?

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Abstract

It may not be practical for small institutions to start up human cadaver labs when implementing new upper level bachelor's courses that focus on the study of human anatomy. It is also not always useful to study the anatomy of other mammals (e.g., cats, pigs, sheep) when trying to learn about human anatomy. One alternative is the Anatomage Table, which provides students with a life-size virtual dissection experience. Currently, little research has been published on the effectiveness of the Anatomage as a learning tool and no research has been published that compares the effectiveness of the Anatomage when learning different organ systems. The purpose of this case study was to examine the effectiveness of the Anatomage Table in learning the musculoskeletal system and nervous system. This study used discussion groups and surveys as methods for collecting data. The sample included 10 students and 1 instructor from 1 gross anatomy course and 16 students and the same instructor from 1 neurobiology course. The findings suggest that this technology is more effective as a learning tool with the musculoskeletal system than the nervous system. This paper discusses the advantages and disadvantages of using the Anatomage Table in gross anatomy and neurobiology and what supplemental resources were utilized in the classroom to reinforce learning of these topics. Recommendations for future research will also be discussed.

1. Introduction

Studying human anatomy is essential for students entering allied health professions. Many undergraduate institutions would prefer to provide students with human cadaver dissection experience, but this may not be practical [1]. This is particularly true of small institutions that are starting up new programs. Virtual dissections can be a valuable alternative to cadaver-based dissections. The Anatomage is one such alternative. Currently the Anatomage Table comes with one male and one female three-dimensional (3D) fully segmented human cadavers. There is an additional female cadaver, but it is not fully segmented like the other two cadavers, and for that reason was not utilized during the gross anatomy or neurobiology courses involved in this study.

The Table is the size of a standard gurney table to offer students a life-size dissection experience. The Anatomage Table works like a tablet, allowing users to easily manipulate the cadavers using just the touch of a finger. Users can easily remove organs and add them back, which gives students an accurate representation of how organs are layered and their relationship to one another. Students are also able to quiz themselves on the Anatomage Table, as the individual organs have labels that can be turned on and off. Certain regions of the male cadaver have been enhanced to view with more detail in the high resolution scans. This allows students to focus in on areas like the forearm, foot, and head with more precise detail. The Anatomage Table also comes with hundreds of 3D scans of normal and abnormal conditions in the image library.

Few studies have addressed the effectiveness of the Anatomage Table as a learning tool in the study of human anatomy. None have evaluated whether this technology is created equal for all organ systems. The purpose of this study was to examine the effectiveness of this technology in learning the musculoskeletal system and nervous system.

2. Methods

The sample included 10 students and 1 instructor from 1 gross anatomy course that was taught during the Spring 2016 semester and 16 students and the same instructor from 1 neurobiology course that was taught during the Fall 2016 semester. The study took place at Maria College, a small private college in Albany, New York, U.S.A. Four of the neurobiology students also took gross anatomy. This was the first time that each of these courses had been taught at Maria College. It was also the first time that the instructors had ever taught these courses. All students and the instructors were female. This is largely due to the student population at Maria College being 85.8% female [2].

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The researcher in this study taught both lecture and lab for gross anatomy, but only taught the lecture for neurobiology. Neurobiology lab was taught by a different instructor. The students were taking these courses as part of their bachelor's degree in health and occupational sciences at Maria College. The majority of the students in these courses would like to pursue a master's degree in occupational therapy after completing this bachelor's degree program. Many already completed or were simultaneously pursuing occupational therapy assistant licensure while taking these courses.

The Anatomage Table was an integral component to the gross anatomy course and was used every week during the laboratory sessions. Each lab primarily utilized the male cadaver on the Anatomage Table. Some labs used the fully segmented female cadaver to identify differences in the skeleton (particularly the pelvis) and in the size of the musculature. The image library with case studies was used on only a few occasions to show abnormal anatomy. It was primarily used to show images of knee replacements. Weekly gross anatomy labs were supplemented with highly detailed, anatomically correct models from a variety of different manufacturers. This included skeletons, both articulated and disarticulated, models of the upper and lower limbs with removable muscles, and models that depict peripheral nerves.

In gross anatomy there were five lab practicals throughout the semester and one cumulative lab practical at the end of the semester. At the end of each lab practical, the instructor would have a discussion session with the students to discuss what could have improved their success on each exam. This included discussing what the instructor and students could have done differently, what each should continue to do moving forward, and what could have been done differently to make each lab practical run more smoothly. Each discussion session involved discussing the pros and cons of the Anatomage. These discussion sessions were held with the intent of improving the course moving forward because, as stated, it was the first time the course had been run at Maria College and the first time the Anatomage Tables were used in any course at the college.

The Anatomage Table was not used as frequently with the neurobiology laboratory. The Table was used when the students were learning about the gross anatomy of the brain, spinal cord, and nerves, and when examining abnormal neural anatomy with the image library on the Anatomage Table. The image library was used more frequently in neurobiology than gross anatomy because the students used various case studies in the image library as a foundation for a class presentation of pathological conditions associated with the nervous system. The neurobiology lab utilized a variety of methods of learning the anatomy of the nervous system in addition to the Anatomage Table. This included a sheep brain dissection, a variety of microscopy activities, and highly detailed, anatomically correct models such as brain models, models that depict peripheral nerves and blood vessel, and models of the spinal cord.

Because the researcher in this study was only teaching the lecture portion of neurobiology, a short survey was created for the students to answer at the end of their third lecture exam to solicit their feedback about their experiences using the Anatomage in neurobiology lab. A different set of survey questions was given to those students who had taken gross anatomy before than those who had not.

3. Results and Discussion

When comparing the students' perceptions of the Anatomage versus the use of models, gross anatomy students preferred learning the skeletal muscles on the Anatomage. On the Anatomage, muscles can easily be removed and added back to see how they sit in relationship to one another. Whereas on the models, only some muscles could be removed and you could not easily identify the origin and insertion of each muscle. The Anatomage also allowed students to more easily see each end of the muscle, which was helpful for them as they had to know the origin and insertion of muscles in addition to being able to identify the muscle by name. On the other hand, students preferred to learn bones on an actual disarticulated skeleton. They felt that the skeleton was easier to study on the disarticulated skeleton because they could easily manipulate the bone with their hand, feel projections on the bones, and orient it on their own body. This difference could also be attributed to the labelling of structures on the Anatomage. All muscles were appropriately labelled, so the students could easily quiz themselves or each other on the Anatomages. For example, they could touch the right pectoralis major muscle and the Table would identify it as such. However, for the bones, if you touch on the humerus it only says, "humerus". It does not identify the different features on the bones (e.g. deltoid tuberosity, medial epicondyle).

Similar feedback was received from students in neurobiology. Some parts of the brain were segmented, but not others. For example, the different lobes of the cerebrum are individually segmented on the brain, but the divisions of the brainstem are not.



The four students who took both gross anatomy and neurobiology felt that gross anatomy was easier to learn on the Anatomage than neurobiology because the structures were larger in gross anatomy and they could physically feel the structures on their own bodies. They could feel different muscles contracting when they were demonstrating the muscles' actions. They could palpate bony prominences under their skin surface. But, they could not feel parts of the brain, spinal cord, or nerves on their own body. The same four students also stated that the Anatomage was easier to learn on in gross anatomy when studying the musculoskeletal system than studying the nervous system in neurobiology.

The findings of this study are in line with the study completed by Custer and Michael [3] in that the advantages of incorporating the Anatomage Tables into the curriculum outweigh the disadvantages. However, this study also found that the Anatomage is more useful when learning some organs and organ systems than others. For example, this study found that the Anatomage is more useful in studying the musculoskeletal system than the nervous system. It also found that within organ systems there are deficiencies on the Anatomage. Although the Anatomage Table overall is an effective alternative when human cadaver dissection is not an option, it is important to supplement the Anatomage Table with other resources like anatomically correct models and diagrams from textbooks and atlases.

One previous study conducted on the Anatomage Tables in 2013 provided mostly unfavorable results when incorporating Anatomage Tables into their first year human structure and function course [4]. It is the thought of this researcher that that could be due in part to the large class sizes that were involved in that study. Maria College offers small class sizes which allow students more individual time and access to the Anatomage Tables. Additionally, since 2013, updates have been performed that have effectively addressed the technological difficulties they experienced during their study. Minimal technological difficulties were experienced with the Tables when using them in the current study at Maria College.

4. Conclusions

Although there is a monetary drawback to the Anatomage Tables because of their high cost, students and faculty at Maria College perceive it as a useful learning tool when studying human anatomy. In order to maximize the use of the Tables, it should be determined if the Anatomages can serve as an effective learning tool in other courses such as human biology and anatomy and physiology I and II. Based on the results of this study, it would be important to take into consideration the advantages and disadvantages of each organ system on the Anatomage before deciding how to integrate the Anatomage into the curriculum. Instructors should do a detailed review of each organ system to determine what would be the most effective use of the Anatomages. This will be helpful in determining the extent to which the Anatomage Tables will be integrated into the curriculum.

Even though the majority of students and faculty at Maria College who have used the Anatomage Tables find them to be an interesting and effective learning tool, further studies need to be done to examine the effectiveness of the Anatomage in studying human anatomy. Although the overwhelming majority of students from both the gross anatomy and neurobiology classes felt that the Anatomage was an effective learning tool, more studies need to be done to compare the effectiveness of the Anatomage to actual dissection of human cadavers and other animals, anatomically correct models, and to other virtual dissection software. Additionally, larger sample sizes are needed for future studies so the data can be generalizable to a larger population.

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